

ORIGINAL ARTICLE

Is adherence to pain self-management strategies associated with improved pain, depression and disability in those with disabling chronic pain?

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Abstract

There is generally good evidence that pain management interventions that include self-management strategies can substantially reduce disability and improve psychological well-being in patients with chronic pain. Reductions in unhelpful responses, especially catastrophising and fear-avoidance beliefs, have been established as key contributors to these gains. In contrast, there is surprisingly little evidence that adherence to self-management strategies contributes to achieving these outcomes. Difficulties in defining and measuring the use of pain self-management strategies have been obstacles for this research. Using a pragmatic way of assessing the practice of specific strategies this study investigated their ability to account for changes in pain, disability and depressive symptoms after a 3-week cognitive-behavioural pain management program. The post-treatment outcomes on these dimensions were found to be statistically and, for many, clinically significant. Consistent with previous research, reductions in catastrophising and fear-avoidance beliefs, and increased pain self-efficacy beliefs, were also associated with these gains. But the key new finding was that there was a clear gradient between adherence to specific self-management strategies and reductions in pain, disability and depressive symptoms. Furthermore, adherence to the self-management strategies was predictive of better outcomes even after controlling for the moderating effects of initial catastrophising, fear-avoidance and pain self-efficacy beliefs.

1. Introduction

To minimise the impact of persisting pain, pain management interventions typically include simultaneous encouragement of active self-management strategies, such as activity pacing, and discouragement of unhelpful responses, such as catastrophising (Keefe et al., 2004).

Strong evidence supports the value of reducing the frequency of catastrophic and other unhelpful responses in pain management interventions (Smeets et al., 2006; Turner et al., 2007). However, apart from

some community data (Blyth et al., 2005), there is remarkably little direct evidence to support the value of using specific pain self-management strategies (Jensen et al., 2007). Some researchers have even questioned the value of widely-used strategies like activity pacing, arguing that it may be a form of activity/pain avoidance (McCracken and Samuel, 2007). In part, the lack of supporting evidence for these strategies may stem from difficulties in defining them and measuring their application. Gill and Brown (2008) also noted evaluating many strategies can depend upon the context in which they are used.

Thus, a strategy to deal with a flare-up in pain would only be relevant at those times. If frequency of use was the only metric, it might underestimate the effectiveness of a strategy that was applied only when needed. This issue was addressed in a recent study by Curran et al. (2009) who examined the effect of adherence to several pain self-management strategies by patients 4 weeks after attending a pain management program. They asked patients to report not just the frequency of their use of these strategies, but also under what conditions they used them (e.g. "when the pain is bad").

Contrary to what has been accepted wisdom (Turk and Rudy, 1991), Curran et al. found the patients' reported practice of active strategies following treatment accounted for only a small proportion of the variance in outcome measures at follow-up. In contrast, they found improved functioning at follow-up was more strongly predicted by the patients' psychological wellbeing (a combination of psychological variables) at post-treatment. While Curran et al.'s results did question the value of encouraging patients to rigidly adhere to specific self-management strategies, it may be important that the practice of these strategies was assessed only at follow-up and retrospectively. As they didn't assess the possible role these strategies may have played in achieving enhanced psychological wellbeing during treatment, their value remains unclear.

Morley and Keefe (2007) have also pointed to the need for research on the degree to which the use of pain coping skills (or strategies) are related to improvements in pain and disability. In this context, these researchers supported the use of applying moderator–mediator methodology (Kraemer et al., 2002) to test the possible effect of patients' pre-treatment characteristics (identified *a priori* as moderators) on treatment outcomes.

Using unhelpful beliefs about pain (catastrophizing, fear-avoidance and low pain self-efficacy beliefs) at baseline as moderators of treatment outcomes in a large sample of chronic pain patients attending a CBT pain management program, we tested adherence to self-management strategies as a mediator of the key post-treatment outcomes of pain, depression and disability.

2. Method

2.1 Participants

Data were derived from consecutive patients admitted to a 3-week (out-patient) pain management program (ADAPT) at the Pain Management and Research Centre, Royal North Shore Hospital, Sydney, Australia,

from 2004 to early 2008. All patients were referred to the Centre by their treating physicians and completed a multidisciplinary assessment at which available treatment options were considered, including the pain program. The inclusion criteria for the program included: aged ≥ 18 years; persisting pain ≥ 6 -months; not considered suitable (after multidisciplinary assessment) for further trials of pain relief treatments; evidence of pain-related disability and/or distress, excessive reliance on medication and other aids to manage pain. Exclusion criteria included inability to speak or read English sufficiently to participate; seeking further medical/surgical interventions for pain; and presence of uncontrolled major psychiatric disorders (e.g. evidence of suicidal intent) that might limit participation. All participants attended the program as a normal treatment rather than a research study. The outcomes were routinely assessed as part of the Centre's quality assurance process. However, as required by the Hospital's Human Ethics Committee, all participants signed an informed consent form providing permission for their de-identified data to be used for research purposes.

As data on the use of self-management strategies were required for this study only those cases that had data on these variables, as well as data on the outcome and cognitive variables at post-treatment were included in this study. Of the 791 patient sample, 224 (28%) had missing data on one or more of these other variables at post-treatment. Reasons for the missing data related mainly to loss of forms and incomplete forms.

No significant differences were found between the included and excluded patients on demographic (age, sex, pain duration) as well as the outcome and cognitive variables at pre-treatment, using a Chi-Square for sex and *t*-tests for continuous variables.

The demographic data obtained on the 567 participants indicated there was a slight majority of women (52%), with 55.5% living with a spouse or partner. The mean age of the sample was 44.0 years (SD: 11.8; range: 18–77 years). The mean duration of pain was 31.2 months (SD: 61.4; range 6–601) and a median of 18.5 months. As in other studies in similar settings (Curran et al., 2009), there was a range of pain complaints and sites, with 72.4% reporting two or more sites. A majority (59.4%) had injury compensation claims (from work or motor vehicle accidents). Most (87.1%) had had 9 or more years of formal education, and 33.8% reported they were still employed in a full or part-time capacity, but 38.2% were unemployed due to pain. Most (88.4%) were also taking one or more types of medication for their pain at admission.

2.2 Measures

Data were gathered on three groups of variables: (1) primary outcomes, (2) cognitive process variables, and (3) pain self-management strategies.

2.2.1 Primary outcome measures

Roland and Morris Disability Questionnaire (RMDQ) (Roland and Morris, 1983). A modified form of the RMDQ was used to measure current pain-related disability. As the present study involved a heterogeneous group of patients, references to back pain from the original RMDQ were removed and the word 'pain' substituted. This modified version of the RMDQ has been reported to have good psychometric properties (Asghari and Nicholas, 2001; Jensen et al., 1992). The RMDQ scores range between 0 and 24, with higher scores indicating more severe physical disability.

Pain intensity scale of the Multidimensional Pain Inventory (MPI). (Kerns et al., 1985) The -item pain intensity scale covers pain in the previous week. The MPI has been shown to have good reliability and validity (Jacob and Kerns, 2001). The scores range between 0 and 6, with higher scores indicating more severe pain.

The depression scale of the Depression Anxiety Stress Scales (DASS). (Lovibond and Lovibond, 1995) was used to measure depression severity. The validity of the DASS with chronic pain patients was reported by Taylor et al. (2005). The scale has also been shown to discriminate reliably between clinical and non-clinical subjects (Antony et al., 1998). The scores range between 0 and 42, with higher scores indicating more severe depressive symptoms.

2.2.2 Cognitive process measures

Cognitive-behavioural theoretical formulations (Keefe et al., 2004; Turk et al., 1983) have posited that adjustment to pain is mediated by cognitions or beliefs. Three key cognitive process variables were assessed in this study:

The pain self-efficacy questionnaire (PSEQ) (Nicholas, 2007) has 10-items and measures the strength and generality of a patient's beliefs about his/her ability to accomplish various activities despite their pain. Scores on the PSEQ range from 0 to 60, with higher scores indicating stronger self-efficacy beliefs. The psychometric properties of this measure are well-established (Nicholas, 2007).

The catastrophising scale of the pain response self-statements scale (PRSS) (Flor et al., 1993). This nine item

scale asks patients to rate on a 0–5 scale (0 = almost never to 5 = almost always) the frequency of catastrophic thoughts when they experience severe pain. The scores in the scale range between 0 and 5, with higher scores indicating more use of catastrophising when experiencing pain. The psychometric properties of the PRSS were established by Flor et al. (1993).

The Tampa Scale for Kinesiophobia (TSK). (Kori et al., 1990) was used to assess fear and avoidance beliefs about movement and re-injury. It contains 17 statements rated on 4-point scales from 'strongly disagree' to 'strongly agree'. The scores range between 17 and 68, with higher scores indicating more severe fear and avoidance beliefs about movement and re-injury. The TSK has been well-validated in pain populations (Vlaeyen et al., 2002).

2.2.3 Use of specific self-management strategies

This was assessed in three steps. (1) The team monitored the performance of each patient on a daily basis throughout the program and checked (daily) that the patients were accurately recording their performances on the specific strategies (and other tasks). If any inaccuracies were detected this was brought to the attention of the patient and they were asked to change their recordings accordingly. This process continued through the program. (2) At the end of each program, in their progress report, the treatment team (nurse, physiotherapist and psychologist) examined each patient's daily worksheets (which recorded their practice of each strategy) and summarised each patient's adherence (in text form, e.g. "using regularly and effectively") for each of seven strategies: activity pacing, using a flare-up plan, stretch exercises, desensitising, thought challenging, fitness exercises and goal setting. For the present study, the use of a flare-up plan was excluded as these were intermittent and fitness exercises were also excluded as they were scheduled each day of the program while stretch exercises were left more to the patients' discretion.

Step (3) involved categorising adherence to the strategies using a 0–2 scale, where 0 = 'not using the strategy at all', 1 = 'using it inconsistently', and 2 = 'using it consistently'. Using 'inconsistently' meant the strategy was used irregularly or less than recommended. Using 'consistently' meant the patient was using the strategy regularly each day and as recommended. These categories were assigned by an independent researcher (MC) not involved in the treatment. As the words used in the reports to describe the degree of adherence to the strategies varied, MC met with the two clinical psychologists responsible for

the progress reports and with the program director (MN) to reach agreement on the meaning of all words used. Three categories were chosen as more would be too fine a discrimination, but two categories (e.g. yes/no) would have lost potentially useful information.

The specific strategies are more fully described in the patients' manual (Nicholas et al., 2004), but briefly:

2.2.3.1. Activity pacing

Performing activities according to individualised quotas and regularly raising the quota levels (e.g. every second or 3rd day) (Gill et al., 1988). The increments are determined by the patient with staff advising, but later by themselves. This step-by-step method allows a patient to gradually achieve specific activity goals largely independent of pain. It is expected to be applied to all activities limited by pain (e.g. sitting, standing, walking, etc.). These steps and practice are recorded in the patients' daily worksheets.

2.2.3.2. Goal setting

Patients identify their activity goals in operational terms (e.g. *walk from the hotel to the hospital without using a stick*). Performing and setting multiple, individually relevant activity goals, which are regularly upgraded, is encouraged throughout the program. As one goal is achieved patients should set new goals that are more demanding. Performance of these activities is recorded in the worksheets daily.

2.2.3.3. Thought challenging

Identifying any unhelpful thoughts (e.g. catastrophising) is encouraged daily and the patients are asked to record these in their worksheets, as well as their responses (challenges) which should reflect an alternative, more helpful way of thinking about (or perceiving) what has happened. This often includes the use of problem-solving methods (Nicholas et al., 2004).

2.2.3.4. Desensitization (interoceptive exposure)

Instead of relaxation training, the patients use a method of desensitizing (or habituating) to their pain by frequent practice of extended exposure to painful sensations (by observing pain in a calm manner, without attempting to control or escape from it) (see Nicholas et al., 2004, for the explanation given to patients, and Flink et al., 2009). Two 20 min practice sessions are held daily and another long session is scheduled at night. Short sessions whenever pain is

troubling are also encouraged. Practice sessions are recorded in the worksheets.

2.2.3.5. Stretch exercises

A daily routine of stretch exercises is encouraged with three sessions recommended daily. These take about 15 min for a full set, but additional practice is also recommended as needed, such as after an exacerbation of pain. The practice of these exercises is recorded in the worksheets as well.

2.3 Treatment

Patients attended in groups of 8–10 daily for 3 consecutive weeks, from 9.00 am to 5.00 pm. The treatment team was a clinical psychologist, physiotherapist, nurse and medical pain specialist, all with many years of experience on the same program. An interdisciplinary style with cognitive-behavioural principles informing all interactions between staff and patients is used throughout the program (Nicholas, 2004). The program is very similar to that of Curran et al. (2009) (see Williams et al., 1996). The key exception being that instead of applied relaxation ADAPT uses interoceptive exposure. All patients are expected to read the manual as part of attending the program.

Achieving functional goals despite pain rather than pain relief is a key goal. Medication for pain is gradually withdrawn during the program. Each patient develops specific and individually meaningful behavioural goals. Patients are expected to be actively involved in the program, participating in all aspects and continuing to practise the strategies taught.

The pain self-management strategies are taught in interactive sessions which include a reformulation of the pain and associated problems, explanation of pain mechanisms, and identification of obstacles to achieving desired goals, and basic problem-solving skills for ways of overcoming these obstacles.

2.4 Analyses

Before examining the effect of adherence to self-management strategies the first step was to establish that there had been some meaningful outcomes achieved by at least a proportion of the patients. Changes in primary outcome and cognitive process measures were assessed in two ways, firstly from a statistical perspective and secondly, from a more clinical perspective. Clinical significance is an attempt to determine whether changes in outcome measures are

substantial enough that they are likely to be meaningful to the patients. The two approaches are described below.

2.4.1 Change from baseline

Using a series of paired sample *t*-tests the pre- to post-treatment change in outcome measures were compared.

2.4.2 Effect sizes

Uncontrolled pre- to post-treatment effect sizes were calculated. It has been argued that an uncontrolled effect size statistic may inflate the apparent effects of treatment compared with a conventional controlled effect size statistic, as it assumes no change without therapy. However, uncontrolled effect size can provide a useful means for comparison between other treatment studies reported in the literature (Westbrook and Kirk, 2005). To calculate treatment effect size the formula used was: $D = \frac{M_1 - M_2}{SD}$. In this formula M_1 the mean at pre-treatment, M_2 is the mean at post-treatment and SD is the standard deviation at pre-treatment. Effect sizes have been classified as small above 0.2, medium above 0.5, and large above 0.8 (Cohen, 1988).

2.4.3 Reliable change estimates/ clinical significance

Relative to estimates of statistical significance, this approach provides a more conservative method for evaluation of treatment outcomes and may be used to gain an indication of the proportion of cases who achieve a change likely to be of clinical significance (Kendal et al., 1999; McCracken et al., 2007; Morley and Williams, 2002). In this study, reliable change estimate cut-off points were calculated, using Jacobson's clinical significance analysis (Jacobson and Revenstorff, 1988; Jacobson et al., 1999). Reliable change indices were calculated using temporal stability data to test if scores change to an extent that is beyond change that could be due to measurement error. For this we used test-retest reliability statistics from a subgroup ($n = 110$) of a sample of patients who completed the measures twice before admission to the program (initial clinic assessment and pre-pain program assessment) but were not in the sample used for this study. The mean interval between the two occasions was 90 days. This is longer than normally used for test-retest analyses and probably under-

estimates the stability of the measures over a shorter period, but we took a conservative approach rather than using data from other studies. The test-retest coefficients for the measures were: Pain intensity ($r = 0.60$), physical disability ($r = 0.74$), pain self-efficacy ($r = 0.56$), depression ($r = 0.74$), fear avoidance ($r = 0.66$), and catastrophising ($r = 0.70$). All correlations were statistically significant ($P \leq 0.001$).

If a patient's score changes to a greater extent than the calculated criterion, then that patient can be described as reliably improved on the measure. To calculate the reliable change index a standard error of difference (S_{diff}) score was calculated for each variable studied. The S_{diff} creates confidence intervals for assessing measurement error.

The steps for calculating the standard error of difference are as follows:

- $SEM_1 = SD_1 \sqrt{1 - r^2}$ (standard deviation from pre-treatment multiplied by the square root of 1 minus the test-retest coefficient).
- $SEM_2 = SD_2 \sqrt{1 - r^2}$ (standard deviation from post-treatment multiplied by the square root of 1 minus the test-retest coefficient).
- $S_{diff} = \sqrt{SEM_1^2 + SEM_2^2}$ (square root of the sum of the squared SEMs for each testing occasion). Then, the S_{diff} is multiplied by 1.96 to obtain 95% confidence intervals.

2.4.4 Prediction of change in outcome measures

A series of multiple regression analyses were conducted to test whether changes in primary outcome measures (depression, physical disability and pain intensity scores) could be predicted by changes in key cognitive process measures (PSEQ, PRSS and TSK) from pre- to post-treatment.

2.4.5 Prediction of change in outcome measures after controlling for the effects of baseline cognitive process variables as moderators

In order to test the contribution of degree of adherence to the self-management strategies (grouped into three clusters) to the changes in outcome measures while controlling for baseline catastrophising, fear-avoidance and pain self-efficacy beliefs a series hierarchical multiple regression analyses were conducted, one for each outcome measure.

2.4.6 Pre-treatment differences between adherence groups

In order to determine if pre-treatment differences in outcome and some key demographic variables could

have contributed to the results we compared the continuous variables (outcome and cognitive process measures) with ANOVAs and the categorical variables (gender and compensation status) with non-parametric, Chi-square tests.

3. Results

3.1 Pre- to post-treatment changes

Changes achieved in the primary outcome variables, as well as the cognitive process variables, are summarised in Table 1.

Significant improvements were achieved in both primary outcome measures and process measures. A more conservative, Bonferroni type correction for multiple comparisons would require $P \leq 0.008$ (i.e., $0.05/6 = 0.008$) for statistical significance and all six comparisons met this criterion.

3.2 Treatment effect sizes

The average effect size for the six variables was 0.69, ranging from 0.42 to 1.01. Considering the cut off points suggested by Cohen (1988), with the exception of pain intensity, for which the effect size was small, the treatment effect size for all other variables are moderate to high.

3.3 Reliable change/clinical significance analyses

Just over 40% of the patients achieved reliable improvements for depression and physical disability.

Almost 30% of patients achieved reliable improvements for pain intensity. The average percentage to achieve reliable changes across the three primary outcome measures was 37.4%. Almost 50% of patients achieved reliable improvements for pain self-efficacy and fear-avoidance, with 40% achieving this level of effect for catastrophising. The average percentage to achieve reliable change across the three cognitive process measures (TSK, PRSS, PSEQ) was 48%.

Overall, statistically significant improvements were achieved in the program and changes which could be considered clinically significant were achieved by about 40% of patients on depression and disability scales. Next we examined whether the cognitive changes were predictive of the changes in the primary outcomes.

3.4 Prediction of change in outcome measures from change in cognitive process variables

Multiple regression analyses revealed that changes in all three primary outcome measures (depression, physical disability and pain intensity scores) were predicted by changes in self-efficacy beliefs (β s for depression, disability and pain intensity were 0.22, 0.40 and 0.31, respectively; all were statistically significant: $P < 0.001$). Similarly, for changes in catastrophising (β s for depression, disability and pain intensity were 0.34, 0.17 and 0.25, respectively; all were statistically significant: $P \leq 0.001$). However, changes in fear-avoidance beliefs were predictive only of change in depression ($\beta = 0.14$, $P < 0.004$) (details available from the first author).

Table 1 Pre- to post-treatment scores (and *t*-test values) on primary outcome and cognitive process measures, uncontrolled treatment effect sizes and clinical significance for pre- to post- treatment changes.

| Variable | Pre-treatment mean (SD) | Pos-treatment mean (SD) | <i>t</i> | UTES | SEM ₁ | SEM ₂ | S _{diff} | Reliable improvement (%) | Reliable decline (%) |
|----------------------------|-------------------------|-------------------------|----------|------|------------------|------------------|-------------------|--------------------------|----------------------|
| Depression (DASS) | 16.3 (11.7) | 10.1 (10.1) | 15.4* | 0.53 | 5.96 | 5.15 | 7.87 | 40.1 | 6 |
| Physical disability (RMDQ) | 12.7 (5.2) | 9.3 (5.7) | 16.2* | 0.65 | 2.65 | 2.90 | 3.92 | 42.3 | 4.3 |
| Pain intensity (MPI) | 4.2 (1.0) | 3.7 (1.1) | 9.05* | 0.42 | 0.62 | 0.72 | 0.95 | 29.8 | 9 |
| Pain self-efficacy (PSEQ) | 25.5 (12.1) | 38.7 (13.8) | 24.1* | 1.01 | 7.84 | 8.94 | 11.80 | 51.7 | 2 |
| Catastrophising (PRSS) | 2.8 (1.1) | 1.9 (1.2) | 16.9* | 0.74 | 0.60 | 0.66 | 0.89 | 42.2 | 4.7 |
| Fear avoidance (TSK) | 39.9 (9.6) | 32.4 (9.6) | 18.8* | 0.79 | 5.59 | 5.59 | 7.90 | 50.1 | 2.9 |

t: *t*-test values.

UTES: Uncontrolled treatment effect size.

SEM₁: Standard error of measurement (pre-treatment).

SEM₂: Standard error of measurement (post-treatment).

S_{diff}: Standard error of difference.

* $P \leq 0.0001$.

3.5 Adherence to pain self-management strategies

3.5.1 Proportions using strategies overall

The data on the consistent use of the nominated strategies indicated six broad adherence groups. Group (1), 177 (31.2% of the total sample) were using all five strategies consistently, (Group 2), 110 (19.4%) using four strategies consistently; (Group 3), 82 (14.5%) using three strategies consistently; (Group 4), 78 (13.8%) using two strategies consistently, (Group 5), 67 (11.8%) using one strategy consistently; and (Group 6), 53 (9.3%) using no strategies consistently.

3.5.2 Adherence to strategies as a mediator, while controlling for the effects of baseline cognitive process variables as moderators, in relation to treatment outcomes

Next, we examined the relationships between these different adherence rate groups for all five strategies (combined) and changes in the outcome variables, as well as their relationships to the baseline cognitive process variables (initial catastrophising, fear-avoidance and pain self-efficacy beliefs) that we identified *a priori* as treatment moderators.

To simplify the analyses, the six adherence groups were collapsed into three clusters: (Cluster 1) those using 4/5 or 5/5 strategies consistently (groups 1 and 2); (Cluster 2) those using 2/5 or 3/5 strategies consistently (groups 3 and 4); and (Cluster 3) those using 1/5 or 0/5 strategies consistently (groups 5 and 6). The relationships between these three clusters and change in the three outcome measures from were examined, using a series of ANOVAs (see Table 2). Table 2 also shows the uncontrolled treatment effect sizes and the percentiles of patients who were categorised as “reliably improved”.

These results indicate that the consistent use of at least 4/5 strategies (Cluster 1) is associated with a greater improvement in pain, disability and depression severity compared to the consistent use of fewer strategies. This effect is statistically significant for all outcome measures when comparing those using at least 4/5 strategies consistently (Cluster 1) versus those using 1–0/5 strategies consistently (Cluster 3). For physical disability, the consistent use of at least 4/5 strategies also conferred a statistically significant advantage over those who used them intermittently (Cluster 2). The effect sizes for those using at least 4/5 strategies consistently were in the medium to high-medium range (0.6–0.78), while those using the strategies less had progressively smaller effect sizes.

The next step was based on the idea of viewing adherence to the strategies as a mediator of the effects of the baseline psychological process (or moderator) variables on the outcome measures. As it has been found previously that the baseline levels of catastrophising, fear-avoidance, and pain self-efficacy beliefs are predictive of outcomes for measures of disability, depression and pain (Nicholas, 2007; Smeets et al., 2006; Turner et al., 2007) it was possible to identify these *a priori* as moderators of the outcomes (Morley and Keefe, 2007). Using hierarchical multiple regression analyses, we sought to test the contribution of degree of adherence to the self-management strategies (according to the three specified cluster groupings) to the treatment outcomes (disability, depression and pain) while controlling for baseline catastrophising, fear-avoidance and pain self-efficacy beliefs. The results are presented in Table 3 and as can be seen we tested two models for each outcome variable; the first tested the effect of adherence to strategies alone on the outcome variables and the second tested the same question while controlling for the influence of the cognitive process (moderator) variables as measured at baseline. The analyses indicate that in every case

Table 2 Effect of consistent/effective use (by adherence cluster, 1–3) of different numbers of strategies, using pre- to post-treatment mean change scores (SD), uncontrolled effect sizes, and Reliable improvement indices to show % that improved.

| Outcome measure | Cl 1 (Nil or 1 strategy) | Cl 2: (2 or 3 strategies) | Cl 3: (4 or 5 strategies) | Results of ANOVA |
|----------------------|---|---|---|---|
| Depression severity | 3.97 (9.86) 0.27 ^a 26% ^b | 5.48 (9.3) 0.47 ^a 33% ^b | 7.68 (9.72) 0.69 ^a 43% ^b | $F = 6.49, P = 0.002$ Tukey HSD: G1 & G3 |
| Physical disability | 2.04 (4.08) 0.37 ^a 30% ^b | 2.98 (4.6) 0.60 ^a 34% ^b | 4.20 (5.12) 0.78 ^a 47% ^b | $F = 8.78, P = 0.001$ Tukey HSD: G1 & G3; G2 & G3 |
| Usual pain intensity | 0.16 (1.00) 0.14 ^a 16% ^b | 0.36 (0.96) 0.39 ^a 24% ^b | 0.56 (1.01) 0.60 ^a 32% ^b | $F = 5.65, P = 0.004$ Tukey HSD: G1 & G3 |

^aUncontrolled treatment effect size.

^bReliable improvement.

Table 3 Hierarchical regression models predicting pre-post treatment change scores in depression disability, and pain, (1) by adherence to strategies alone and (2) by adherence to strategies (mediators) when controlling for the baseline measures of pain self-efficacy, catastrophising and fear avoidance (moderators).

| Predictors | R ² change | F change | Probability F change | Beta | Significance level |
|--|-----------------------|----------|----------------------|-------|--------------------|
| <i>Criterion variable: Change in depression from pre treatment to post treatment</i> | | | | | |
| <u>Model 1</u> | | | | | |
| Step 1: Strategies | 0.024 | 12.82 | 0.001 | 0.15 | 0.001 |
| <u>Model 2</u> | | | | | |
| Step 1: Baseline measures | 0.12 | 18.97 | 0.001 | | |
| Pain self-efficacy | | | | -0.11 | 0.84 |
| Catastrophising | | | | 0.32 | 0.001 |
| Fear avoidance | | | | 0.03 | 0.56 |
| Step 2: Strategies | 0.028 | 14.03 | 0.001 | 0.17 | 0.001 |
| <i>Criterion variable: Change in disability from pre treatment to post treatment</i> | | | | | |
| <u>Model 1</u> | | | | | |
| Step 1: Strategies | 0.036 | 19.68 | 0.001 | 0.19 | 0.001 |
| <u>Model 2</u> | | | | | |
| Step 1: Baseline measures | 0.08 | 1.14 | 0.33 | | |
| Pain self-efficacy | | | | -0.10 | 0.09 |
| Catastrophising | | | | 0.02 | 0.67 |
| Fear avoidance | | | | 0.06 | 0.27 |
| Step 2: Strategies | 0.046 | 20.72 | 0.001 | 0.22 | 0.001 |
| <i>Criterion variable: Change in pain from pre treatment to post treatment</i> | | | | | |
| <u>Model 1</u> | | | | | |
| Step 1: Strategies | 0.019 | 10.04 | 0.002 | 0.14 | 0.002 |
| <u>Model 2</u> | | | | | |
| Step 1: Baseline measures | 0.01 | 1.57 | 0.18 | | |
| Pain self-efficacy | | | | -0.10 | 0.09 |
| Catastrophising | | | | 0.08 | 0.30 |
| Fear avoidance | | | | -0.05 | 0.30 |
| Step 2: Strategies | 0.03 | 14.25 | 0.001 | 0.18 | 0.001 |

adherence to the strategies accounted for a small, but significant ($P < 0.001$) and independent proportion of the variance in outcomes over and above the effects of the baseline measures of the process (moderator) variables.

To further examine the effects of adherence to the strategies on changes in the cognitive process (moderator) variables (which we found in 3.4 to be predictive of change in the outcome variables), we used a series of bivariate regression analyses to test the effects of adherence on changes in the process (moderator) variables. A summary of the results is presented in

Table 4. These indicate that higher degrees of adherence to the strategies were predictive of greater pre-post treatment changes in the three cognitive process variables (catastrophising, fear-avoidance and pain self-efficacy beliefs).

3.5.3 Adherence to strategies and other baseline characteristics

To check if there were differences between the adherence clusters on the outcome (pain, depression and disability) and cognitive process variables (catastroph-

Table 4 Regression analysis predicting pre-post treatment changes in pain self-efficacy, catastrophising and fear avoidance according to level of adherence to the strategies (in clusters 1–3).

| Criterion measure | Predictors | R ² | F | Probability F | Beta | Significance level |
|------------------------------|------------|----------------|-------|---------------|------|--------------------|
| Change in pain self-efficacy | Strategies | 0.05 | 24.55 | 0.001 | 0.21 | 0.0001 |
| Change in catastrophising | Strategies | 0.03 | 14.42 | 0.001 | 0.17 | 0.0001 |
| Change in fear-avoidance | Strategies | 0.06 | 29.85 | 0.001 | 0.25 | 0.001 |

ising, fear-avoidance and pain self-efficacy beliefs) at admission, a series of one-way ANOVAs comparing combined adherence clusters 1 (4–5 strategies), 2 (2–3 strategies), and 3 (0–1 strategy) were conducted. Mean pain, depression and disability were in the moderately severe range typically found in patients attending pain management centres, with the mean depression level in this sample worse than just over 60% of patients attending the same centre over a 10 year period (Nicholas et al., 2008). However, no significant differences were found on either initial outcome or cognitive process variables, except that mean pain intensity was slightly higher in Cluster 3 than the other two Clusters. This would seem of marginal significance given no differences between clusters on baseline disability and depression ratings.

As compensation status and sex have previously been found predictive of differential treatment outcomes, these variables were analysed with χ^2 analyses. Differences were found between the three adherence clusters in proportions of cases with compensation claims. The data are not shown, but there was a gradient in proportion of cases in each cluster who had a compensation claim, from 72% in Cluster 3 (0–1 strategy) to 57% in Cluster 1 (4–5 strategies), with Cluster 2 (2–3 strategies) in between with 69% having a claim ($\chi^2 = 10.4$, $df = 2$, $P = 0.006$). There was also a significant difference in sex balance between clusters, with significantly more women (57.4%) in Cluster 1 (4–5 strategies), versus 39.9% in Cluster 3 (0–1 strategy) ($\chi^2 = 11.02$, $df = 2$, $P = 0.004$). Cluster 2 (2–3 strategies) was in between, with 51.3% women.

4. Discussion

Overall, statistically significant improvements were achieved on the three primary outcome measures at post-treatment. From a 'benchmarking' perspective, these changes were at levels consistent with outcomes from other comprehensive, multidisciplinary pain management programs (Jensen et al., 2001; McCracken et al., 2007; Smeets et al., 2006; Williams et al., 1999). Just over 40% of patients met the more stringent criteria of clinically significant changes for improved depression severity and disability; while almost 30% met this criterion for pain reduction. Significant improvements were also found in the three cognitive process variables: catastrophising, fear-avoidance beliefs and pain self-efficacy beliefs. These changes in process variables were also predictive of improvements in the primary outcome measures,

consistent with previous findings (Burns et al., 2003; Jensen et al., 2001; Sullivan et al., 2006; Turner et al., 2007).

The key new finding was that practising at least 4/5 of the nominated pain self-management strategies consistently during treatment was associated with improvements in pain, disability and depression at post-treatment. There was a clear gradient for worse outcomes with less consistent practice. Importantly, adherence to the self-management strategies was still predictive of improvements in the outcome variables even after controlling for initial levels of pain self-efficacy, catastrophising and fear-avoidance beliefs. When it is considered that baseline levels of these cognitive process variables have been found to be predictive of outcomes, our finding suggests the strategies offer something over and above the levels of these cognitive process variables alone, consistent with long-standing cognitive-behavioural formulations of treatment (e.g., Turk et al., 1983).

From the perspective of mediator–moderator methodology (Kraemer et al., 2002), and consistent with the call by Morley and Keefe (2007), these results indicate that the use of pain coping skills (or pain self-management strategies) can be viewed as having a mediating effect on pre-treatment psychological moderators of treatment outcomes.

Overall, the present findings provide support for the use of self-management strategies in pain management interventions. Nevertheless, adherence to the self-management strategies alone may not be sufficient to ensure improvements as other factors also contributed to treatment changes, including the cognitive process variables. This study cannot determine the direction of influence between the cognitive process variables and the self-management strategies, but clearly, training pain patients to use these strategies is something clinicians can address directly, in addition to the other common elements of pain management programs, such as pain education (Moseley et al., 2004) and behavioural exposure (de Jong et al., 2005). However, while the individual strategies (e.g. activity pacing) studied here may be of interest in their own right, we cannot comment on their value as the relationship between adherence to the individual strategies and outcomes was not specifically tested in this study. This question will be addressed subsequently.

Some comment should be made about the role of baseline depression in this study. Despite a moderately severe mean depression level for the sample at baseline (see Nicholas et al., 2008, for normative data), this did not seem to limit treatment responses in those

who applied the self-management strategies, unlike some earlier studies (Cherkin et al., 1996; Sullivan et al., 2006). A possible explanation for this difference relates to the treatment 'dose'. Sullivan et al. found those with higher depression levels were less responsive to ten individual sessions with a psychologist and suggested more sessions might be required for this group. In the more comprehensive treatments, such as the program tested here and the similar one in Williams et al. (1999), a substantial proportion of patients with moderate levels of depression achieved significant improvements in depressive symptoms and disability. Significantly, Williams et al. showed lasting differential benefits for the group that received comprehensive inpatient treatment, relative to those that received a briefer version of the same approach as outpatients. Not surprisingly, our results would seem to echo those of Williams et al.

The finding that significantly more of those who adhered to the strategies were women and did not have a compensation claim suggests these factors may play a moderating role on outcomes, in addition to the baseline cognitive process variables (e.g. Vlaeyen and Morley, 2005). Others have reported similar findings. Harris et al. (2005) found having a compensation claim was associated with poorer responses to surgical treatments. Skouen et al. (2006) found a comprehensive multidisciplinary pain management program in Norway was more effective in returning women to work, relative to men. Jensen et al. (2005) in Sweden and Keogh et al. (2005) in the UK found greater improvements in quality of life by women relative to men after similar programs. But why women might be more prepared than men to make changes to their pain management strategies is unclear.

The findings about adherence reported by Curran et al. (2009) may appear inconsistent with those reported here, but this is not necessarily so. As the self-management strategies examined in the two studies were very similar, one explanation for the different findings is that adherence to the strategies may be varied according to need or circumstances – as suggested by Curran et al. Differences in methodology between the two studies provides support for this perspective.

Unlike Curran et al., the present study assessed both changes in psychological well-being pre- to post-treatment and adherence throughout treatment, rather than adherence only over the post-treatment period. In addition, the present study calculated the proportion of patients treated who made changes likely to be considered clinically significant. Predominantly, it was this group that practised the self-

management strategies consistently throughout the treatment. Thus, while Curran et al. found adherence to these strategies may be less important following substantial improvements in psychological wellbeing, our findings suggest that adherence to the strategies was associated with the achievement of improved psychological wellbeing during treatment, alongside reductions in catastrophising and fear-avoidance beliefs, plus enhanced pain self-efficacy beliefs. This might suggest that once a patient had achieved a threshold of improvement, actual practice of the strategies could be modified according to circumstances and perhaps integrated into normal daily activities.

The limitations of this study include uncertainty about the measurement of self-management strategies. As noted by Curran et al. (2009), this is an underdeveloped area with many previous studies relying on retrospective self-reports of unknown reliability and validity. The method used here included self-reports, and like Carmody and Baer (2008), these were made on the day of the behaviour not weeks later, but unlike Carmody and Baer, they were checked by observers. It could be argued that our method of categorising the use of strategies into three broad levels was too restrictive and risks losing variance as well as overlooking potentially important individual differences that could have shed more light on the role of these strategies. As a result we may have underestimated the value of these strategies, but we felt it better at this stage to err on the side of conservatism. Even so, the differences we did find suggest it is worth pursuing the topic further. It is also possible the treatment team were biased, but it seems unlikely the team would have been motivated by anything other than trying to report the patients' performances accurately (this was a treatment setting not a research project). While the study does provide some support for the validity of the method used, there is clearly a need for improved adherence measures (e.g. Broekmans et al., 2009). Another limitation is that relatively few self-management strategies were assessed. There are many others that could be considered (e.g. Turner et al., 2006), but we restricted the focus to those that are commonly taught in programs like ours. The reliance on self-report measures for outcomes, especially disability, is also a weakness. However, the Roland and Morris scale is widely-accepted as a meaningful index of pain-related disability and the changes found were consistent with established criteria of clinical significance (Deyo et al., 1998). Finally, having no control group the study cannot establish causal relationships between the strategies and the changes in the outcome measures. Nevertheless, the results are

consistent with cognitive-behavioural theories that posit the use of self-management strategies as central to improvements in adjustment to persisting pain and in limiting the impact of pain on people's lives (Morley and Keefe, 2007).

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